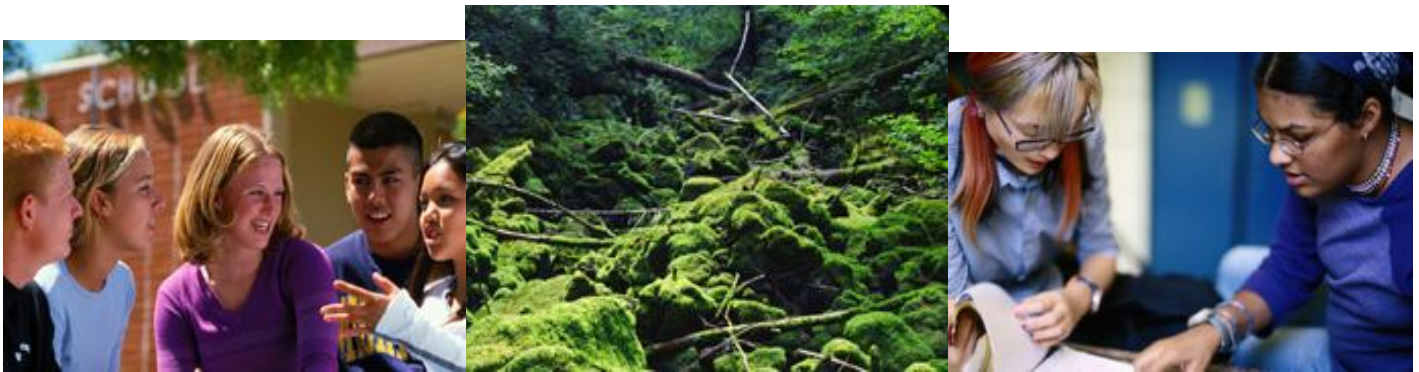




Cool School Challenge



Classroom Audit Kit (7th - 12th grade)

Version 4.0 | June 2012

A climate education audit kit to challenge students, teachers, and schools to reduce their carbon footprint.



Cool School Challenge: Audit Kit

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Acknowledgements

Authors

Jennifer Murck, National Wildlife Federation
Jennifer Hammonds, National Wildlife Federation
Jessica Aronson, Puget Sound Energy
Kimberley Cline, Puget Sound Clean Air Agency
Mike Town, Redmond High School

Design and layout

Kimberley Cline, Puget Sound Clean Air Agency
Jennifer Murck, National Wildlife Federation

Special thanks to the Cool School Challenge planning team

Jessica Aronson | Program Manager, Powerful Choices for the Environment, Puget Sound Energy
Kimberley Cline | Communications Specialist, Puget Sound Clean Air Agency
Lynne Dial | Facilitator, Powerful Choices for the Environment, Puget Sound Energy
Katie Fleming | Education Coordinator, RE-Sources for Sustainable Communities
Jane Howard | Facilitator, Powerful Choices for the Environment, Puget Sound Energy
Dave Reid | Program Manager, Cool School Challenge, Puget Sound Energy
Sandy Sieg | Program Manager, Low Income Weatherization, Puget Sound Energy
Mike Town | AP Environmental Science Teacher, Redmond High School
Mike Wierusz | Director, One Earth Solutions

Additional Contributions

Thank you to the following individuals for reviewing, editing and contributing to these materials.

Nora Accetturo, Puget Sound Energy
Dale Alekel | Green Schools Program Manager, King County Department of Natural Resources & Parks
Stella Bass | Science Teacher, Washington Middle School
Ted Brown, Puget Sound Energy
Chuck Collins | Resource Conservation Manager, Lake Washington School District
Ted Cox | Science Teacher, Bellevue High School
Noam Gundle | Science Teacher, Ballard High School
Danielle Harrington, City of Olympia
Rhonda Hunter | Environmental Education Manager, Washington Department of Ecology
Rem Husted, Puget Sound Energy
John Inch | Environmental Educator, City of Tacoma
Stephanie Leisle | Environmental Educator, Pierce County Public Utilities
Jessica Levine | Teacher, Eckstein Middle School
Heather Mulligan, Puget Sound Energy
Stephanie Rohdy, Puget Sound Energy
Marcia Rutan | Community Recycling Specialist, Seattle Public Utilities
John Schmied | Science Teacher, Skyview Junior High School
Joel Smith, Puget Sound Energy
Leslie Stanton | Climate Change Lead, Puget Sound Clean Air Agency
Jake Wade, Puget Sound Energy
Amy Warren | Communications Specialist, Puget Sound Clean Air Agency



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Classroom Audit Kit

This kit supports [Step 1: Conduct an Audit](#) and [Step 4: Monitor & Evaluate](#) which are outlined in the Implementation Guide. It includes:

- ♦ **Classroom Audit**. Use the Audit to gather data about classroom electricity use, heating, waste generation and recycling, and transportation both before and after the Challenge.
- ♦ **Classroom Calculation Worksheets**. The enclosed worksheets will help you calculate classroom emissions based on the results of the Audit. You will compare before-and-after totals to measure your school's progress toward reducing its climate impact.
 - [To streamline calculations, you can also use the Classroom Carbon Calculator Excel spreadsheet available at \[coolschoolchallenge.org\]\(http://coolschoolchallenge.org\).](#)

Instructions:

You'll conduct the audit process twice: at the beginning of the Challenge as part of [Step 1](#), where you will collect baseline information about current classroom behaviors that may be contributing to its carbon footprint, and then again in [Step 4](#) after you've implemented your Action Plan, to see how well each classroom did at reducing its climate impact. This information will help you project the CO₂ reductions possible if the classroom continued climate-protecting behaviors for the entire school year.

1. Begin by reviewing the background information in the Classroom Audit.
2. Conduct the Audit.
3. Use the information gathered in the Audit to estimate classroom emissions by either using the calculation worksheets or the Excel classroom calculator.

Hint: Be sure to keep your "Pre-Challenge" Audit results and calculations from [Step 1](#) handy so you can compare results in [Step 4](#).

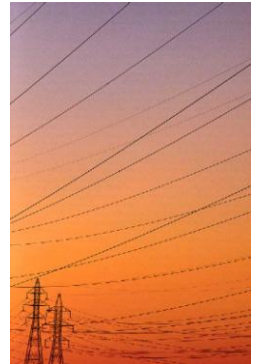


Classroom Audit

Use the enclosed “Classroom Audit” form (or feel free to create your own!) to gather data about classroom electricity use, transportation, heating, and waste generation and recycling habits. Audit each classroom twice: first at the *beginning* of the Challenge to gather preliminary data and then again at the *end* of the Challenge, to see whether classrooms successfully met their CO₂ emissions reduction goals. To help get you started, review this background information on each of the categories you’ll be auditing.

Background information

Electricity used by schools for lighting and powering computers, televisions and other devices contributes to emissions of carbon dioxide (CO₂), a greenhouse gas. Reducing the amount of electricity used can help lower CO₂ emissions. In this part of the Classroom Audit you’ll take a look at how much energy is being used to light the classroom, power computers and other electrical devices, and also hunt for energy “vampires.”



LIGHTING

Most classrooms are lit by overhead light panels, commonly equipped with 32-watt fluorescent bulbs. In conducting your audit, look for the number and type of bulbs powered by each light switch, as well as for any other lights that might be in the classroom (such as desk lamps). If you cannot find the wattage of the bulbs, use 32-watts as your default or check with your custodian. Also find out how many hours the lights are kept on during a typical school day.



ENERGY “VAMPIRES”

Lights aren’t the only devices that use electricity. Take a look around the classroom. In addition to classroom lights, what else is using electricity? Are there any computers, projectors or DVD/VCR players? Appliances suck up energy even when they are not being used - which is why they are sometimes referred to as “energy vampires.” Vampires include devices with digital clocks (like DVD players) or internal remote control sensors (like some televisions), which draw energy just from being plugged in. Reducing vampire loads is as easy as plugging the appliance into a power strip and then turning off the power strip when not in use. Because computers and other electronics are usually put to good use during school sessions, this exercise

focuses only on what happens to electronic equipment *after* school hours to see how much energy is being wasted.

In this part of the Classroom Audit, take an inventory of the different electric devices and find out whether they are left on in “active” mode overnight, put to “sleep” or turned completely “off.” Refer to the table below for a description of the different operating modes. If devices are plugged into a power strip, find out whether the power strips are actually turned off at the end of the day.

COMMON OPERATING MODES FOR ELECTRIC DEVICES

MODE	
“Active”	Device is on and serving its primary function. (Example: a DVD player playing a movie, or a computer running a program.)
“Sleep/Standby”	Device is in low-power mode. (Example: DVD player is on but not playing a disc; computer is on but in power-save/sleep mode.)
“Off”	Device is turned off but still plugged in and ready for action. (Example: DVD player is turned off but could be activated by remote. Digital displays will be visible.)
“Power strip/ Unplugged”	Device is plugged into a power strip, which is turned off at the end of the day. Or - the electronic device is unplugged. (Example: DVD player is receiving NO power. Digital display is NOT on and cannot be activated by remote.)

ELECTRICAL APPLIANCES (OPTIONAL)

During the school day, energy “vampires” and other appliances transform into useful tools to help you learn. Nonetheless, you might want to know how much energy they consume during active use. In conducting your audit, look for the wattage of each classroom appliance and estimate how many hours each day the device is on. If the wattage is not listed on the appliance, you can still estimate it by finding the current draw (in amperes) and multiplying that by the voltage used by the appliance. Most appliances in the United States use 120 volts. The amperes might be stamped on the appliance in place of the wattage. If not, find a clamp-on ammeter - an electrician's tool that clamps around one of the two wires on the appliance—to measure the current flowing through it. You can obtain this type of ammeter in stores that sell electrical and electronic equipment. Take a reading while the device is running: this is the actual amount of current being used at that instant. If you cannot find or measure the current draw, the average wattages for typical pieces of classroom equipment are listed in **Section 1: Electricity References.**



Transportation

How ‘carbon-ated’ is your commute? Different ways of getting to and from school affect our climate differently. Some options, such as driving alone in an inefficient, low mileage vehicle, generate more carbon dioxide emissions than others, such as riding a bike, taking the bus or walking. For

simplicity, the Classroom Audit focuses just on how the teacher of your assigned classroom gets to and from school. (For the über-dedicated climate crusaders, you can assess the transportation choices of the entire student body by conducting the Transportation Audit.) Find out how far and by what means each teacher travels to and from school each day. For teachers that drive, ask what kind of mileage their vehicle gets. If they aren’t sure, ask for the make and model of their car and look it up at www.fueleconomy.gov.

Heating

Keeping schools warm and cozy inside when it’s cool outside uses a lot of energy, which in turn generates CO₂ emissions. Measuring these emissions and finding ways to reduce them can be challenging and depend on many variables. For example, the type of fuel used to generate heat, the number of windows, the quality of insulation, and the age and location of the school building all figure into energy use and related CO₂ emissions. Most of these are variables that individual students and teachers have no control over. One thing students and teachers *can* do, though, is adjust classroom temperature, if there is a controllable thermostat. For this category of the Classroom Audit, find out if the classroom has a controllable thermostat and, if so, to what temperature it is set.



No control? Classrooms without controllable thermostats cannot do much to influence how much energy they use for heat, but there are other ways to save CO₂ through simple behavioral changes. For example, closing and opening windows or doors can affect the amount of energy that classrooms use. Include some of these tips in your Action Plan.

Solid Waste/Recycling



According to the EPA, about 4.4 pounds of waste is generated per person per day in the United States. Over the course of one school year (180 days), that adds up to 792 pounds of waste per person! Waste affects the environment in a number of ways, ranging from the greenhouse gases released after it’s dumped in a landfill and the emissions associated with transporting that waste to the landfill, to the emissions generated just to produce that item in the first place. According to the U.S. Environmental Protection Agency, each pound of waste produces roughly 1.75 pounds

of greenhouse gas pollution as it journeys from your trash can to the landfill.¹ Fortunately, there are many ways to shrink your waste - and greenhouse gas emissions - by reducing, reusing and recycling.

In this section of the Classroom Audit you will look at how much trash each classroom generates in a week. Also examine whether wasteful habits are in practice - such as using only one side of paper for printing/copying, or drinking bottled water or coffee from a paper cup, instead of using a reusable container. Just one 'grande' size paper coffee cup is responsible for one-quarter pound of greenhouse gas pollution.² Does the classroom recycle? Americans use roughly 60 billion plastic bottles every year - nearly 7 million an hour - yet only one bottle out of every five is recycled.³ Filling a reusable water container or bringing your own mug helps reduce waste, save resources and cut down on emissions.

¹ Source: EPA, <http://www.epa.gov/osw/nonhaz/municipal/index.htm>

² **Source:** Environmental Defense and Pew Charitable Trust, http://www.edf.org/documents/523_starbucks.pdf

³ **Source:** Container Recycling Institute, <http://container-recycling.org/images/plastic/graphs/PETrecsale-units-96-06.gif>



Audit Forms

ELECTRICITY – CLASSROOM LIGHTING				
Switch	How many bulbs per switch?	Watts per bulb	# hours per day the switch is on	
			Before Taking Action	After Taking Action
1				
2				
3				
4				
5				

ELECTRICITY – ENERGY VAMPIRES									
Electronic Device	How Many?	End of Day: (check one per device)							
		“Active” (on and performing main function)		“Sleep/Standby” (on, ready-for-action but not in use)		“Off” (turned off, but still plugged in)		“Power strip” (Plugged into power strip, which is turned off at end of day)	
		Before Taking Action	After Taking Action	Before Taking Action	After Taking Action	Before Taking Action	After Taking Action	Before Taking Action	After Taking Action
Desktop Computer									
Laptop Computer									
Computer Monitor – Conventional (CRT)									

Computer Monitor – Flat Screen (LCD)									
Multi-Function Printer/Scanner/Copier									
Stereo									
Television									
DVD/VCR Player									
Smart Board									

ELECTRICITY – OTHER APPLIANCES (Optional)				
Electronic Device	How Many?	Wattage	Hours On Per Day	
			Before Taking Action	After Taking Action

TRANSPORTATION, HEATING & SOLID WASTE

CATEGORY		Before Taking Action	After Taking Action
TRANSPORTATION	1. What is the roundtrip distance the teacher travels to and from school each day?	_____ miles	_____ miles
	2. How many days per week does the teacher use each mode of transportation to get to school?	_____ drive alone _____ carpool _____ walk, bike, bus	_____ drive alone _____ carpool _____ walk, bike, bus
	⇒ If the teacher drives alone or carools, what is the car's fuel efficiency in miles per gallon, mpg?	_____ drive alone- mpg _____ carpool- mpg	_____ drive alone- mpg _____ carpool- mpg
	⇒ If teacher doesn't know mpg, what is the make and model of the car? (This will allow you to look up its fuel economy online)	_____ make _____ model	_____ make _____ model
	⇒ If the teacher carools, how many people total are in the carpool?	_____ passengers	_____ passengers
HEATING	1. Is there a controllable thermostat in the classroom, main office, or at the district level?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
	2. If so, to what temperature is it set?	_____ warm weather _____ cold weather	_____ warm weather _____ cold weather
	3. How is your school heated?	_____ electricity _____ fuel oil _____ natural gas	_____ electricity _____ fuel oil _____ natural gas

TRANSPORTATION, HEATING & SOLID WASTE continued...

CATEGORY		Before Taking Action	After Taking Action
SOLID WASTE & RECYCLING	1. Approximately how many <u>full</u> bins of trash does the classroom generate each week?	_____ Full Bins	_____ Full Bins
	2. How much does the trash can weigh when empty	_____ Pounds	_____ Pounds
	3. How much does the trash can weigh when filled with trash	_____ Pounds	_____ Pounds
	4. Does the classroom recycle?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
	⇒ If yes, what does the classroom recycle? <i>Check all that apply:</i>	_____ Paper _____ Plastic _____ Aluminum _____ Cans _____ Glass	_____ Paper _____ Plastic _____ Aluminum _____ Cans _____ Glass
	5. Approximately how many reams of paper are used by the classroom per week?	_____ Reams	_____ Reams
	⇒ What is the recycled content of the paper?	___ 0% ___ 30% ___ 100%	___ 0% ___ 30% ___ 100%
	⇒ Are both sides of the paper used for printing?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
	6. If the teacher drinks bottled water/soda, approximately how many plastic bottles does he/she use each week?	_____ Bottles	_____ Bottles
	⇒ Most of the time, are the bottles usually recycled, or thrown away?	<input type="checkbox"/> Recycled <input type="checkbox"/> Thrown Away	<input type="checkbox"/> Recycled <input type="checkbox"/> Thrown Away
	7. If the teacher drinks coffee/tea or other beverages, does he/she use his/her own mug?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
	⇒ Approximately how many disposable cups does he/she consume in a week?	_____ Cups	_____ Cups

SCHOOL QUESTIONS

1. Is climate change education a part of the school's curriculum?	<input type="checkbox"/> Yes <input type="checkbox"/> No
2. Have students attended or participated in a Cool the Earth* or an ACE+ assembly?	<input type="checkbox"/> Yes <input type="checkbox"/> No
3. Have students create awareness campaigns around different climate change topics?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4. Do students understand the Earth is a system made of smaller systems including the biosphere, hydrosphere, atmosphere and lithosphere?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Do students understand that CO2 is a part of the carbon cycle and that the carbon we emit locally travels globally?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6. Do students understand the greenhouse effect?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7. Do students understand the Earth's energy budget?	<input type="checkbox"/> Yes <input type="checkbox"/> No
8. Do students participate in service learning projects related to the environment?	<input type="checkbox"/> Yes <input type="checkbox"/> No
9. Do students participate in citizen science programs? i.e. Project Budburst, GLOBE, Project Feeder Watch, etc.	<input type="checkbox"/> Yes <input type="checkbox"/> No

Classroom Calculation Worksheets

With your completed Classroom Audit handy, it's now time to calculate the CO₂ emissions from each classroom you audited. Follow the steps below and record your information on the enclosed **Worksheets**. Note that you will complete this process twice: first to estimate the classroom's emissions *before* the Challenge, and then again at the *end* of the Challenge to measure progress toward meeting classroom Challenge goals. (NOTE: You can use the Excel carbon calculator found at www.coolschoolchallenge.org if you do not want your students to do the calculations by hand.)

The Classroom Carbon Calculator includes:

- ♦ Section 1: Electricity
 - Worksheet 1A: Classroom Lighting
 - Worksheet 1B: Energy Vampires
 - Worksheet 1C: Classroom Appliances (OPTIONAL)
 - Worksheet 1D: Calculate kWh and Cost Savings (OPTIONAL)
 - Electricity References
- ♦ Section 2: Transportation
 - Worksheet 2: Transportation
- ♦ Section 3: Classroom Heating
 - Worksheet 3: Classroom Heating
- ♦ Section 4: Solid Waste/Recycling
 - Worksheet 4A: Classroom Trash
 - Worksheet 4B: Classroom Paper Use
 - Worksheet 4C: Plastic Water Bottles
 - Worksheet 4D: Disposable Beverage Cups

ENERGY VAMPIRES

Similar to your approach with classroom lighting, begin by first estimating the electricity consumed by energy vampires (appliances that suck up energy even when they aren't in use) in kWh; then calculate the associated CO₂ emissions. This will measure the "phantom load" of the classroom. Finally, at the end of the Challenge, compare CO₂ emissions before and after the Challenge, to see how much progress the classroom made toward shrinking its carbon impact.



1. Estimate electricity from energy vampires in kWh.

- Record the data gathered in your Classroom Audit into the appropriate columns of **Worksheet 1B: Energy Vampires.**
- Refer to **Section 1: Electricity References** to determine the wattage of each appliance in different operating modes and record your information into Worksheet 1B. For any appliance that is either unplugged, or plugged into a power strip AND turned off at night, record a "0" in the Watts per Hour column.
- Convert the watts to kilowatts and then to kilowatt-hours, based on a 16-hour 'night.' Record your answers in the "Classroom Results" section of Worksheet 1B.

Note:

⇒ Assume the devices are actively being used during an 8-hour school day. This exercise will only measure kWh used during the 16 hours *outside* regular school hours to see how much energy is being wasted.

Electricity is measured in kilowatt-hours (kWh)

1 kilowatt = 1000 watts

kWh = kilowatts x hours the appliance is on

2. Estimate CO₂ emissions from energy vampires.

- As you did with Classroom Lighting, first select the utility that provides electricity to your school from **Section 1: Electricity References** (page 32). This will let you know how many pounds of CO₂ the utility creates per kilowatt-hour of electricity. This is called the "CO₂ conversion factor." If you do not know your school's electricity provider, or if it isn't listed, just use the national average.
- Enter the appropriate CO₂ conversion factor for your school onto **Worksheet 1B.**
- Determine how many pounds of CO₂ energy vampires generate each day by multiplying the "Total kWh consumed per night" by the utility's CO₂ conversion factor.

- Add it all up!** How many pounds of CO₂ would the classroom generate if energy vampires sucked up the same amount of electricity *all year*? Record your answer in the "Summary of Results" box.

CLASSROOM APPLIANCES (OPTIONAL)

Similar to your approach with classroom lighting and energy vampires, begin by first estimating the electricity consumed by classroom appliances in kWh; then calculate the associated CO₂ emissions. Finally, at the end of the Challenge, compare CO₂ emissions before and after the Challenge, to see whether the classroom made any changes.

1. Estimate electricity from electrical appliances in kWh.

- a. Record the data gathered in your Classroom Audit into the appropriate columns of **Worksheet 1C: Classroom Appliances.**
- b. Refer to **Section 1: Electricity References** to determine the wattage of each appliance when in use and record your information into Worksheet 1C.
- c. Convert the watts to kilowatts and then to kilowatt-hours, based the hours per day each device is on. Record your answers in the “Classroom Results” section of Worksheet 1C.

Note:

Electricity is measured in kilowatt-hours (kWh)
1 kilowatt = 1000 watts
kWh = kilowatts x hours the appliance is on

2. Estimate CO₂ emissions from classroom appliances.

- a. As you did with Classroom Lighting and Energy Vampires, first select the utility that provides electricity to your school from **Section 1: Electricity References** (This will let you know how many pounds of CO₂ the utility creates per kilowatt-hour of electricity. This is called the “CO₂ conversion factor.” If you do not know your school’s electricity provider, or if it isn’t listed, just use the national average.
 - b. Enter the appropriate CO₂ conversion factor for your school onto **Worksheet 1C.**
 - c. Determine how many pounds of CO₂ classroom appliances generate each day by multiplying the “Total kWh consumed per night” by the utility’s CO₂ conversion factor.
3. **Add it all up!** How many pounds of CO₂ would the classroom generate if classroom appliances used the same amount of electricity *all year*? Record your answer in the “Summary of Results” box.
4. **Calculate kWh and Cost savings!** How many kWh does your classroom save per year? How many dollars will your school save because of your reduced electricity use? Record your answer in the “Summary of Results” box.

Worksheet 1A: CALCULATE EMISSIONS FROM CLASSROOM LIGHTING

1. Enter the CO₂ Conversion Factor for your school's utility in the box, at right.
2. Record data from your Classroom Audit into the table below and calculate emissions from lighting by multiplying total kWh by the CO₂ conversion factor.

Utility Conversion Factor
_____ lbs CO₂ per kWh

INPUT CLASSROOM DATA HERE

1	2	3	4	5	6	
Switch	# of bulbs per switch	Watts per bulb	Total watts per switch	Kilowatts per switch	# of hours per day the switch is on	
					Before Taking Action	After Taking Action
1						
2						
3						
4						
5						

CLASSROOM RESULTS:

7		8	
Total kilowatt-hours per day (Kilowatts x Hours)		Total pounds of CO ₂ per day	
Pre-Challenge	Post-Challenge	Pre-Challenge	Post-Challenge

Total lbs of CO₂ emissions from lighting per day:

SUMMARY OF RESULTS

1. Enter the before and after taking action daily CO₂ totals into the appropriate boxes, to the right.
2. Now estimate the **annual** emissions, and enter the results in the appropriate boxes to the right.
(Hint: there are 180 days in a typical school year.)

	CO ₂ Emissions per day (lbs)	CO ₂ Emissions per 180-day school year (lbs)
Before Taking Action		
After Taking Action		

Worksheet 1B: CALCULATE EMISSIONS FROM ENERGY VAMPIRES

Utility Conversion Factor
_____ lbs CO₂ per kWh

1. Enter the CO₂ Conversion Factor for your school's utility in box at right
2. Record data from your Classroom Audit into the table below.
3. Refer to **Section 1: Electricity References** to find the "Watts per Hour" for the operating mode of each device.
4. Calculate emissions from ENERGY VAMPIRES by multiplying total kWh by the CO₂ conversion factor.

INPUT CLASSROOM DATA HERE

Electronic device	How many?	End of day operating mode		Watts per hour	
		Before Taking Action	After Taking Action	Before Taking Action	After Taking Action
Desktop computer					
Computer monitor, conventional (CRT)					
Computer monitor, flat screen (LCD)					
Laptop computer					
Printer					
DVD/VCR Player					
LCD Projector					
Television, Conventional or LCD					
DVR/TiVo					

CLASSROOM RESULTS:

Total kWh consumed overnight		Total CO ₂ emissions per 16-hour "night" (lbs)	
Before Taking Action	After Taking Action	Before Taking Action	After Taking Action

Total lbs of CO₂ emissions from vampires per 'night':

--	--

SUMMARY OF RESULTS

1. Enter the before and after taking action "nightly" CO₂ totals into the appropriate boxes, to the right.
2. Now estimate the annual emissions, and enter the results in the appropriate boxes to the right. (Hint: there are 180 days in a typical school year.)

	CO ₂ Emissions per 'night' (lbs)	CO ₂ Emissions per 180-day school year (lbs)
Before Taking Action	<input style="width: 80px; height: 30px; border: 1px solid orange;" type="text"/>	<input style="width: 80px; height: 30px; border: 1px solid orange;" type="text"/>
After Taking Action	<input style="width: 80px; height: 30px; border: 1px solid blue;" type="text"/>	<input style="width: 80px; height: 30px; border: 1px solid blue;" type="text"/>

Worksheet 1D: ****OPTIONAL**** CALCULATE KWH AND COST SAVINGS

With this worksheet you can calculate how much energy the classroom could save each year, as well as the potential cost savings of using less electricity.

How much electricity could the classroom save each year?

- Record your electricity data from Worksheets 1A, 1B and 1C into the table below.
- Calculate kWh savings by subtracting the After Taking Actions result from Before Taking Actions result.

INPUT CLASSROOM DATA HERE:

Electricity Category	Total kWh consumed per year	
	Before Taking Action	After Taking Action
Classroom Lighting		
Energy "Vampires"		
Other Appliances		
Totals:		

CLASSROOM RESULTS:

Annual kWh savings per 180-day school year

How much money could the classroom save each year by reducing electricity use?

- Enter the cost per kWh for your school's region in box at right. (You'll find this in **Electricity References**)
- Calculate the **cost** of the electricity consumed by your classroom before and after taking action.
- Calculate the cost savings by subtracting the after taking action cost from the before taking action cost.

Cost per kWh:
 _____ \$ per kWh

INPUT CLASSROOM DATA HERE:

Electricity Category	Total kWh consumed per year	
	Before Taking Action	After Taking Action
Classroom Lighting		
Energy "Vampires"		
Other Appliances		

Totals:

CLASSROOM RESULTS:

Total \$\$ spent on electricity per year	
Before Taking Action	After Taking Action
\$	\$
\$	\$
\$	\$
\$	\$

\$\$ saved per 180-day school year
\$
\$
\$
\$

SUMMARY OF RESULTS

Total kWh Savings per Year:

Total \$\$ Saved per year:

Section 1: Electricity References

Here you will find information about utility conversion factors (how many pounds of carbon dioxide are emitted per kilowatt-hour of electricity, as well as the different operating modes and wattages for energy vampires.

Note: See Methodology Note 1 for an explanation of how the utility conversion factors were derived, or to derive one for your specific utility.

Cost per Kwh		
Energy source	Cost	Units
Electricity (WA)	\$0.07	\$/kWh
Electricity (CA)	\$ 0.13	\$/kWh
Electricity (TX)	\$0.09	\$/kWh
Electricity (VA)	\$0.09	\$/kWh
Electricity (NY)	\$0.16	\$/kWh
Electricity (US)	\$0.10	\$/kWh

Source: Energy Information Administration, average prices as of January 30, 2012;
<http://www.eia.gov/electricity/state/>

COMMON OPERATING MODES FOR ELECTRONIC DEVICES	
MODE	DESCRIPTION
“Active”	Device is on and serving its primary function. (Example: a DVD player playing a movie, or a computer running a program.)
“Sleep/Standby”	Device is in low-power mode. (Example: a DVD player is on, but not playing a disc, or a computer is on, but in power-save mode.)
“Off”	Device is turned off, but still plugged in and ready for action. (Example: DVD player is turned off, but could be activated by remote. Digital displays will be visible.)
“Power strip/ Unplugged”	Device is plugged into a power strip, which is turned off at the end of the day. Or - the electronic device is unplugged. (Example: DVD player is receiving NO power. Digital display is NOT on and cannot be activated by remote.)

Source: ACEEE: <http://www.aceee.org/consumer/home-electronics>

Utility CO ₂ Conversion Factors	
Pounds (lbs) CO ₂ per kWh by utility	
Utility	Lbs CO ₂ per kWh
Washington state average	0.3
California state average	.61
Texas state average	1.34
Virginia state average	1.08
New York state average	.68
National average	1.39

Source: 2009 Utility Fuel Mix Report, State of Washington Department of Commerce, 2009.
<http://www.commerce.wa.gov/site/539/default.aspx>

WATTAGE OF SELECT ENERGY VAMPIRES IN COMMON OPERATING MODES

Appliance	Off (but plugged in)	“Sleep”: On but not in use	Active (on and in use)
	(watts)	(watts)	(watts)
Desktop Computer	2.84 watts	21.13 watts	73.97 watts
Laptop Computer	8.9 watt	15.77 watts	44.28 watts
Conventional (CRT) Monitor	0.8 watts	12.14 watts	65.1 watts
Flat screen (LCD) Monitor	1.13 watt	1.38 watts	27.61 watts
Multi-Function Printer/Scanner/Copier	5.26 watts	9.16 watts	15 watts
LCD Projector	3 watts	6 watts	230 watts
Television, <40” CRT or LCD	3.06 watts	N/A	100 watts
DVD/VCR player	5.04 watt	13.51 watts	15.33 watts
SMART board	1 watt	2 watt	301 watts

Sources: Compiled from Puget Sound Energy and ECOS Consulting, 2006: Final Field Research Report for the California Energy Commission; available from the American Council for an Energy Efficient Economy; <http://aceee.org/consumerguide/electronics.htm> ; Standby Power: <http://standby.lbl.gov/summary-table.html>; SMART Board: www.smarttech.com

Section 2: Transportation

Using the findings from the Classroom Audit, calculate the teacher's CO₂ emissions from his/her commute to and from school.

1. Estimate the amount of fuel burned per day from the teacher's commute.

- a. Enter your data from the Classroom Audit on Worksheet 3: Transportation.
- b. Calculate how many gallons of gas are burned per commute.
- c. If the teacher carools, determine how many gallons are burned per person. Do this by dividing total gallons burned by the carpool vehicle by the total number of passengers in the carpool.
- d. If the teacher walks, bikes or rides the bus to school, fuel burned = ZERO.



Gallons used per day = Miles traveled per day ÷ mpg

Lbs of CO₂ per day = 20 lbs CO₂ x gallons used per day

According to the U.S. EPA, the combustion of one gallon generates approximately 20 lbs. of CO₂.

Source: <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

2. Estimate CO₂ emissions from the teacher's commute.

- a. If the teacher carools, divide total emissions by the number of people who share the ride.
- b. If the teacher walks, bikes or rides the bus to school, CO₂ emissions equal ZERO*.

3. Add it all up! How many pounds of CO₂ would be produced if the teacher commuted the same way *all year*? Record your answer in the "Summary of Results" box.

* Although buses produce emissions, they run regardless of the number of passengers they carry. For the purpose of this exercise it is assumed that a teacher who rides the bus is not generating any *additional* emissions.



Worksheet 2: TRANSPORTATION

Roundtrip distance traveled _____ miles per day

INPUT CLASSROOM DATA HERE:

Transportation Mode	Before Taking Action	After Taking Action
If the teacher ever <u>drives alone</u> to school:		
What is the mileage of the vehicle he/she drives? (mpg)		
How many days per week does the teacher drive alone to work?		
If the teacher ever <u>carpools</u> to school:		
What is the mileage of the carpool vehicle? (mpg)		
What is the total number of people traveling in the carpool?		
How many days per week does the teacher carpool to work?		
If the teacher ever <u>walks, bikes or rides the bus</u> to school:		
How many days per week does the teacher commute by walking, biking or riding the bus?		

CLASSROOM RESULTS:

Carbon Impact	Before Taking Action	After Taking Action
⇒ Gallons of gasoline burned each day:		
⇒ Gallons of gasoline burned each week:		
Pounds of CO ₂ emitted per week:		
⇒ Gallons of gasoline burned each day:		
⇒ Gallons of gasoline burned per person each day:		
⇒ Gallons of gasoline burned per person each week:		
Pounds of CO ₂ emitted per person per week:		
⇒ Enter a "0". These climate-friendly modes of transportation do not generate any additional emissions.		

SUMMARY OF RESULTS

- Sum the weekly pounds of CO₂ emitted from driving alone, carpooling, walking, biking, and riding the bus and enter the pre-and post-Challenge weekly CO₂ totals into the appropriate boxes, to the right.
- Now estimate the **annual** emissions, and enter the results in the appropriate boxes to the right.
(Hint: there are 36 weeks in a typical school year)

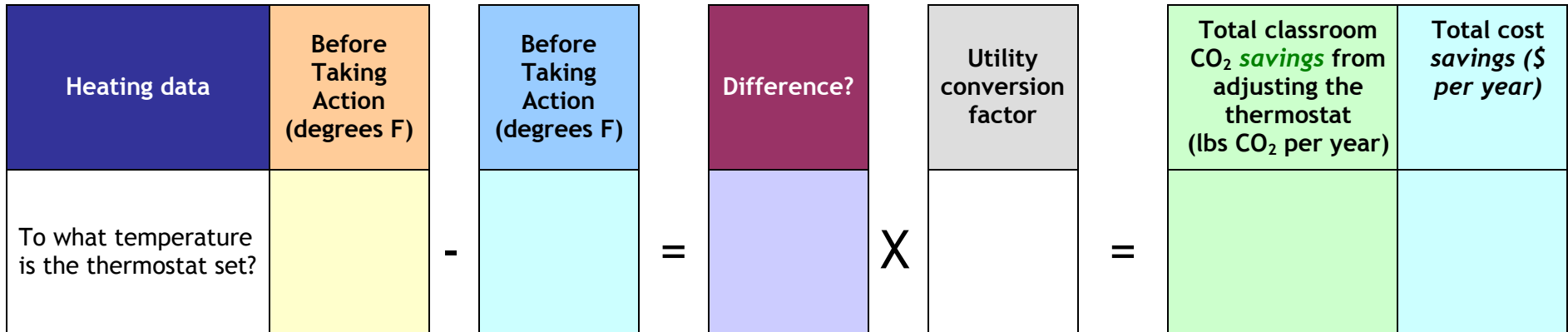
	CO ₂ emissions per week (lbs)	CO ₂ emissions per 36-week school year (lbs)
Before Taking Action	<input type="text"/>	<input type="text"/>
After Taking Action	<input type="text"/>	<input type="text"/>

Section 3: Heating

Complete this section only if the classroom has an adjustable thermostat and during the Challenge, turned down the temperature. Rather than calculate the emissions *generated* from heating as in other sections, here you will estimate the emissions that could be *prevented* by turning down the heat.

- 1. Find out how your school is heated.** Is your school heated by natural gas? Fuel oil? Electricity? If electricity, who is your school's utility? The type of fuel used to heat your school affects its carbon impact. Refer to the "Conversion Factors" table below to find the source of energy that most closely fits your school. If you don't know how your school is heated, just use the "National Average." Enter this value in the appropriate place in [Worksheet 4: Classroom Heating](#).
- 2. Estimate CO₂ emissions from classroom heating.**
 - a. Enter data from the Classroom Audit into the appropriate columns.
 - b. Did the classroom turn down its thermostat during the Challenge? If so, by how many degrees?
 - c. Calculate emissions savings by multiplying the number of degrees the thermostat was turned down by the conversion factor for your utility.
- 3. Estimate cost savings.**
 - a. Calculate cost saving based on the figures in the Cost Savings table on the worksheet

Worksheet 3: CLASSROOM HEATING



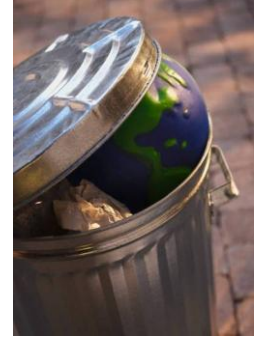
Conversion Factors			
Pounds (lbs) of CO ₂ saved per year per degree thermostat is turned down, by utility and energy source.			
Utility	Electricity	Natural gas	Fuel oil
Puget Sound Energy	397.5		
Seattle City Light	7.5		
Snohomish County Public Utility District	67.5		
Tacoma Power	22.5		
National Average	510		
Other		113.5	167.8

Cost Savings	
Dollars saved per year per degree thermostat is turned down, by source and region.	
Energy source	Cost
Electricity (WA)	\$26.25
Electricity (US)	\$37.50
Natural gas (WA)	\$1.16
Natural gas (US)	\$1.16
Fuel oil (US)	\$27.80

Note: Refer to Methodology Note 2 for explanation on how these factors were derived.

Section 4: Solid Waste/Recycling

Using the findings from the Classroom Audit, calculate the classroom's CO₂ emissions and savings from solid waste and recycling. At the end of the Challenge you'll explore how well the classroom did in reducing, reusing and recycling and see how generating less waste and using materials more efficiently helped the climate!



CLASSROOM TRASH

Follow the instructions on [Worksheet 4A: Classroom Trash](#) to:

1. Estimate the amount of trash (in pounds) generated by the classroom each week;
2. Estimate CO₂ emissions from classroom trash; and
3. **Add it all up!** How many pounds of CO₂ would the classroom produce if it generated the same amount of garbage *all year*? Record your answer in the "Summary of Results" box.

CLASSROOM PAPER USE

1. Estimate CO₂ emissions from paper use.
 - a. Enter data from the Classroom Audit into [Worksheet 4B: Classroom Paper Consumption](#).
 - b. Paper made from recycled paper generates less climate pollution than paper made from raw materials. Refer to the "Conversion Factors - Paper" table on [Worksheet 4B](#) to see how many pounds of CO₂ the classroom's paper generates per ream. Enter the factor that matches the recycled content of the paper on your Worksheet. For example, a classroom that uses paper with 30% recycled content generates 13 lbs of CO₂ per ream.
 - c. Calculate the CO₂ emissions from classroom paper consumption.



Lbs of emissions = # of reams x CO₂ conversion factor

2. **Add it all up!** How many pounds of CO₂ would the classroom generate if it used the same amount of paper *all year*? Record your answer in the "Summary of Results" box.

PLASTIC WATER BOTTLE CONSUMPTION

One pound of plastic generates 2.3 pounds of greenhouse gases, from the extraction of raw materials to produce the plastic, to the manufacturing of the bottles, to transporting the bottles to the store, etc. Recycling plastic water bottles can help reduce that impact by shrinking the need to create brand new bottles. To determine the climate impact of this classroom's plastic water bottle habit, first determine how many pounds of plastic are used and whether water bottles are usually recycled.



2. Estimate the amount of plastic (in pounds) generated by the number of plastic water bottles used each week.

- Enter your data from the Classroom Audit on [Worksheet 4C: Plastic Water Bottle Consumption](#).
- Estimate the amount of plastic used each week.

$$\text{Lbs of plastic} = \# \text{ of bottles} \times 0.04 \text{ lbs}$$

(One 16 oz plastic water bottle weighs approximately 0.04 lbs)

3. Estimate CO₂ emissions from plastic water bottles.

- Determine the CO₂ emissions created from the plastic in the water bottles. Enter your total on [Worksheet 2D](#).

$$1 \text{ lb of plastic} = 2.3 \text{ lbs of CO}_2$$

- If water bottles are usually *recycled*, the climate impact can be reduced. Each pound of plastic that is recycled *saves* 1.6 pounds of CO₂. Estimate CO₂ savings by multiplying lbs of plastic (from Step 1 above) by 1.6, and then subtracting that from the total in 2a. This is the new CO₂ total.
4. **Add it all up!** How many pounds of CO₂ would be produced if the same amount of plastic water bottles were used **all year**? Record your answer in the “Summary of Results” box.

DISPOSABLE BEVERAGE CUPS

- Estimate CO₂ emissions from disposable beverage cups. Follow the instructions on [Worksheet 4D: Disposable Beverage Cups](#).

$$\text{One 16-oz “grande” size cup} = 0.25 \text{ lbs of CO}_2$$



- Add it all up!** How many pounds of CO₂ would be produced if the same amount of disposable cups were used **all year**? Record your answer in the “Summary of Results” box.

Worksheet 4A: CLASSROOM TRASH

To determine how many pounds of CO₂ each classroom generates from the trash they throw away, you'll first need to figure out how many pounds of trash they create. Rather than weigh every classroom's trash can, you will estimate this by using your own classroom's bin as a model. Because the size and type of trash receptacles in schools varies, for simplicity we suggest using the trash bin in your classroom as the standard for your school. Ambitious challengers are welcome to audit every trash can in the school for more accurate results! Just copy this procedure for each classroom participating in the Challenge.

1. Weigh your own classroom's trash can when it's empty, to see how heavy the can is by itself.
2. Weigh the bin again when it's full.
3. Subtract the weight of the empty bin from the weight of the full bin.

The difference = # of pounds of trash in a full classroom trash can.

4. Enter this value in Column 1 of the table below.
5. Record your answer from the Classroom Audit in Column 2.
6. One pound of trash generates roughly 1.75 lbs of CO₂. Calculate how many pounds of trash and CO₂ the classroom generates each week.

1 lb of trash generates 1.27 lbs CO₂
http://www.epa.gov/climatechange/waste/calculators/Warm_Form.html

INPUT CLASSROOM DATA HERE:

Column 1	Column 2	
Pounds per full trashcan (enter from #3 above)	How many full trash bins per week?	
	Before Taking Action	After Taking Action

CLASSROOM RESULTS:

Column 3		Column 4	
Pounds of trash per week		Pounds of CO ₂ per week (lbs trash x 1.75 lbs CO ₂)	
Before Taking Action	After Taking Action	Before Taking Action	After Taking Action

=

Total lbs CO₂ from classroom trash generated per week

--	--

SUMMARY OF RESULTS

1. Enter the before and taking action weekly CO₂ totals into the appropriate boxes, to the right.
2. Now estimate the **annual** emissions, and enter the results in the appropriate boxes to the right. (*Hint: there are 36 weeks in a typical school year.*)

	CO ₂ Emissions per week (lbs)	CO ₂ Emissions per 36-week school year (lbs)
Before Taking Action		
After Taking Action		

Worksheet 4B: CLASSROOM PAPER CONSUMPTION

Lbs of emissions = # of reams x CO₂ conversion factor

INPUT CLASSROOM DATA HERE:

Paper Consumption	Before Taking Action	After Taking Action
1. How many reams of paper are used by the classroom per week, on average?		
2. What is the recycled content of the paper?		
3. Enter the CO ₂ per ream, refer to the "Conversion Factors - Paper" table below.		

CLASSROOM RESULTS:



Carbon Impact	Before Taking Action	After Taking Action
Calculate weekly CO ₂ emissions and enter your totals in the columns to the right.		

Conversion Factors- Paper	
Pounds (lbs) CO ₂ equivalent per ream of paper, by recycled content	
Recycled content (%)	Lbs CO ₂ per ream
0-30%	13
40-50%	12
60-70%	11
75-80%	10
90-100%	9

Notes: Unit of measurement is CO₂ equivalents and includes CO₂ emissions from burning fossil fuels as well as methane from paper decomposing in landfills. Estimates based on a standard, 5-lb ream of copy paper. Environmental impact estimates were made using the Environmental Defense Paper Calculator. For more information visit <http://www.papercalculator.org>.

SUMMARY OF RESULTS

1. Enter the before and taking action weekly CO₂ totals into the appropriate boxes, to the right.
2. Now estimate the *annual* emissions, and enter the results in the appropriate boxes to the right. (*Hint: there are 36 weeks in a typical school year.*)

TIP: If you print double-sided, you waste less paper and generate fewer emissions.

	CO ₂ Emissions per week (lbs)	CO ₂ Emissions per 36-week school year (lbs)
Before Taking Action	<input type="text"/>	<input type="text"/>
After Taking Action	<input type="text"/>	<input type="text"/>

Worksheet 4C: PLASTIC WATER BOTTLES

Plastic Water Bottle Consumption	Before Taking Action	After Taking Action
If the teacher drinks bottled water, approximately how many plastic water bottles does he/she go through each week?		
Most of the time, does the teacher usually recycle the water bottles, or throw them away ? (“Recycle” or “Toss”)		

⇒

Resource Impact	Before Taking Action	After Taking Action
How much plastic is that? (lbs) 1 water bottle = 0.04 lbs of plastic.		
If the water bottles are usually recycled , the carbon impact is reduced by 1.6 lbs of CO ₂ per lb of plastic.		

⇒

Carbon Impact	Before Taking Action	After Taking Action
1. Emissions: Each pound of plastic creates 2.3 lbs of CO ₂ .		
2. Savings from recycling bottles:		
3. Total Emissions (subtract #2 from #1, above)		

⇒ ⇒ ⇒

SUMMARY OF RESULTS

1. Enter the before taking action weekly CO₂ totals into the appropriate boxes, to the right.
2. Now estimate the **annual** emissions, and enter the results in the appropriate boxes to the right.
(Hint: there are 36 weeks in a typical school year.)

	CO ₂ Emissions per week (lbs)	CO ₂ Emissions per 36-week school year (lbs)
Before Taking Action	<input type="text"/>	<input type="text"/>
After Taking Action	<input type="text"/>	<input type="text"/>

Worksheet 4D: DISPOSABLE BEVERAGE CUPS

Enjoying a daily coffee or cocoa in a paper cup adds up to a lot of waste! Bringing your own mug helps reduce waste, save resources and cut down on emissions. If in the Classroom Audit **SOLID WASTE/RECYCLING** section the teacher answered “yes” to drinking beverages from disposable cups, complete this section to estimate the CO₂ implications of those choices.

A typical 16-oz “grande” size beverage cup with lid and sleeve generates 0.25 lbs of CO₂

INPUT CLASSROOM DATA HERE:

Beverage Cup Consumption	Before Taking Action	After Taking Action
If the teacher drinks coffee, tea or other beverage, does he/she usually use his/her own mug? (Yes or No)		
Approximately how many disposable cups does he/she use in a week?		

CLASSROOM RESULTS:

Carbon Impact	Before Taking Action	After Taking Action
Calculate weekly CO ₂ emissions and enter your totals in the columns to the right. <i>1 cup = 0.25 lbs CO₂ emissions</i>		



SUMMARY OF RESULTS

1. Enter the before and taking action weekly CO₂ totals into the appropriate boxes, to the right.
2. Now estimate the **annual** emissions, and enter the results in the appropriate boxes to the right.
(Hint: there are 36 weeks in a typical school year.)

	CO ₂ Emissions per week (lbs)	CO ₂ Emissions per 36-week school year (lbs)
Before Taking Action		
After Taking Action		

Add it all up!



Now that you've calculated the classroom's emissions from electricity, solid waste and transportation and heating, add them up to determine the total carbon footprint.

As you complete the 'Before Taking Action' and the 'After Taking Action', record the values from each Worksheet into the table below. At the end of the Challenge, subtract your "After Taking Action" results from your "Before Taking Action" results to estimate the potential emissions and cost savings if each classroom took action on climate change the entire school year. Divide the classroom total by the number of students in the classroom to estimate the emissions and potential savings per student.

Audit category	Estimated CO ₂ Emissions per year				Potential emissions savings (lbs)	Potential cost savings (\$\$)
	Before Taking Action (lbs)	After Taking Action (lbs)				
Classroom lighting			-	⇒		
Energy 'vampires'			-	⇒		
Other appliances (<i>optional</i>)						
Transportation			-	⇒		n/a
Heating	n/a	n/a	-	⇒		
Classroom trash			-	⇒		n/a
Classroom paper			-	⇒		n/a
Plastic water bottles			-	⇒		n/a
Beverage cups			-	⇒		n/a
TOTAL:			-	⇒		

Emissions per student	Before Taking Action	After Taking Action	Change
Number of students in class			
Pounds of CO ₂ per student			⇒

School Tally



Once you've added up the total from your classroom, you can work with other classes to add up a total for the whole school. The online Tally Sheet is the easiest way to this. You can download the Tally Sheet at www.coolschoolchallenge.org. Data from the 'Add it all Up!' worksheet can be entered directly into the Tally Sheet Classroom report, shown below. Ask other classrooms for their completed 'Add it all Up!' worksheet or completed 'Classroom Carbon Calculator' Excel workbook to get a total for your whole school!

Classroom (teacher/room #):

Number of students:

Audit category	Estimated CO ₂ emissions per year		Potential savings per year	
	Before Taking Action (lbs)	After Taking Action (lbs)	CO ₂ Emissions Savings (lbs)	Electricity Savings (kWh)
Classroom lighting				
Energy "vampires"				
Other appliances				
Transportation				n/a
Heating				n/a
Classroom trash				n/a
Classroom paper				n/a
Plastic water bottles				n/a
Beverage cups				n/a
TOTAL				



Methodology Note 1:

Deriving Electric Utility CO₂ Emissions Factors

The carbon dioxide emissions factors for electric utilities were derived using the following methodology:

1. Identify the fuel mix profile of your state (the percentage of electricity generated by each resource).
 - Fuel mix profiles for the fifty states can be found online via Get Energy Active: Keep Our Fuel Mix Diverse - What's the Fuel Mix Where I Live? <http://www.getenergyactive.org/fuel/state.htm>
 - National electric power data compiled from Get Energy Active - Current National Fuel Mix, <http://www.getenergyactive.org/fuel/mix.htm>
2. For each carbon-based fuel source, multiply its percentage contribution by the CO₂ emissions per kWh for that resource.
3. Add up the percentages for the total CO₂ emissions per kWh.

CARBON DIOXIDE EMISSION FACTORS FOR CARBON-BASED ELECTRICITY RESOURCES:

Fuel	Pounds of CO ₂ /kWh
Coal:	2.249 lbs CO ₂ /kWh
Oil	1.679 lbs CO ₂ /kWh
Natural Gas	1.135 lbs CO ₂ /kWh

Source: U.S. Environmental Protection Agency:
<http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html>

Notes:

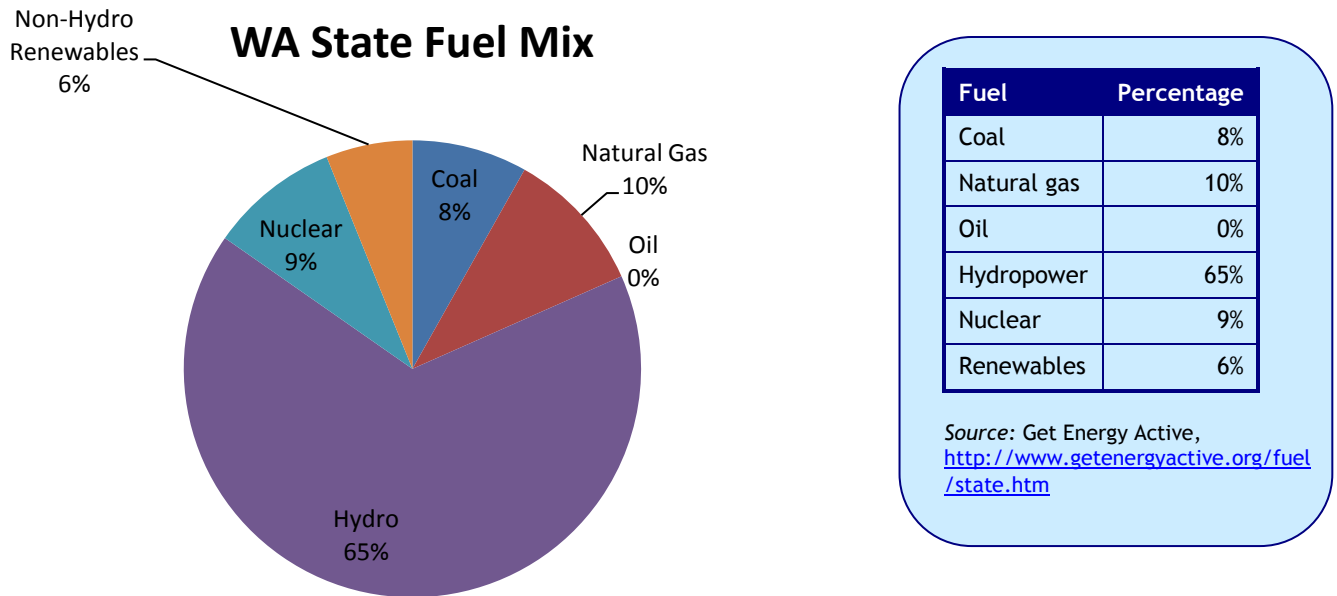
Renewable energy sources such as hydropower, wind, solar and geothermal heat generate little if any emissions of carbon dioxide because no fuels are combusted. Though the burning of biomass produces carbon dioxide, it is considered to be part of the natural carbon cycle of the earth. Nuclear power plants do not emit carbon dioxide.



EXAMPLE

Using Washington state profile as an example, here is how its CO₂ emissions factor of **.3 lbs/kWh** was derived.

1. Washington’s fuel mix profile consists primarily of hydropower, nuclear and natural gas:



2. Multiply the percentage contribution of each carbon-based fuel source by the corresponding emission factor.

Fuel	Percentage		Emission factor		Lbs CO ₂ /kWh
Coal	8%	x	2.249	=	0.17992
Natural gas	10%	x	1.135	=	0.1135
Oil	0%	X	1.679	=	0

3. Add it up!

$$0.17992 + 0.1135 + 0 = 0.29342 \text{ lbs CO}_2/\text{kWh.}$$

=> **With rounding, Washington state generates ≈ 0.3 lbs CO₂/kWh of electricity.**



Methodology Note 2:

Deriving CO₂ Savings for Heating Adjustment

For the Heating section of the Cool School Challenge audit, we used the following conversion factors to estimate the carbon dioxide savings of turning down classroom thermostats one degree:

Pounds (lbs) CO ₂ saved per year per degree thermostat is turned down, by utility and energy source.			
Utility	Electricity	Natural gas	Fuel oil
Puget Sound Energy	397.5		
Seattle City Light	7.5		
Snohomish County Public Utilities District	67.5		
Tacoma Power	22.5		
National Average	510		
Other		113.5	167.8

These conversion factors were derived using the following approach:

- Determine the amount of energy (kWh) an average classroom uses each year.** Puget Sound Energy (PSE) conducted a state-wide "School Building Benchmark Audit²" which collected and analyzed energy use data from many schools across Washington State. This data determined that an average 900 sq ft classroom consumes:

 - 12,492 kWh/year, if electricity is the energy source for heating.
 - 323 therms/year, if natural gas is the energy source for heating.
- Determine energy saved by turning down the thermostat in a classroom one degree.** PSE determined that each degree a classroom thermostat was turned down correlated with a 3 percent savings in energy. This equates to savings of:

 - 375 kWh/year for schools that heat with electricity.
 - 9.7 therms/year for schools that use natural gas as their energy source for heating.

² Younger, Bill, CEM. (2005). *School Building Benchmark Survey*. Puget Sound Energy.



3. For schools that rely on electricity for heating:

- A. Derive the CO₂ emissions factor (lbs CO₂/kWh) for its utility. Refer to “Cool School Challenge Methodology Note 1: Deriving Electric Utility CO₂ Emissions Factors” for guidance.
- B. Convert the kWh savings to CO₂ savings. Multiply the energy savings factor identified in #2 above (375 kWh/year) by the utility’s CO₂ emissions factor. For example, the emissions factor for Puget Sound Energy is 1.06 lbs CO₂/kWh. If a classroom heated by electricity from PSE turned down its thermostat one degree, its CO₂ savings would be:

$$(375 \text{ kWh/yr}) \times (1.06 \text{ lbs CO}_2/\text{kWh}) = 397.5 \text{ lbs CO}_2 \text{ saved per degree thermostat is turned down}$$

4. For schools that rely on natural gas or fuel oil for heating, convert the therm savings to CO₂ savings. Multiply the energy savings factor identified in #2 above (9.7 therms/year) by the corresponding emission factor for natural gas or fuel oil.

Example:

Natural gas: $(9.7 \text{ therms/year}) \times (11.7 \text{ lbs CO}_2/\text{therm}) = 113.5 \text{ lbs CO}_2 \text{ saved per degree thermostat is turned down}$

Fuel oil: $(9.7 \text{ therms/year}) \times (17.3 \text{ lbs CO}_2/\text{therm}) = 167.8 \text{ lbs CO}_2 \text{ saved per degree thermostat is turned down}$

5. To determine the cost savings, the electricity and natural gas savings are multiplied by the average costs per kWh and therm, respectively.

Conversion Factors			
Energy source	Cost	Units	\$/degree/year
Electricity (WA)	\$0.07	\$/kWh	\$26.25
Electricity (US)	\$0.10	\$/kWh	\$37.50
Natural gas (WA)	\$0.12	\$/therm	\$1.16
Natural gas (US)	\$0.12	\$/therm	\$1.16
Fuel oil (US)	\$2.88	\$/gallon	\$27.80

CARBON DIOXIDE EMISSION FACTORS FOR CARBON-BASED ENERGY FUELS:

Fuel	Pounds of CO ₂ /therm
Natural Gas	11.7 lbs CO ₂ /therm
Oil	17.3 lbs CO ₂ /therm

Source: U.S. Department of Energy, Energy Information Administration: <http://www.eia.doe.gov/oiaf/1605/coefficients.html>; convert emissions factor from kg to lbs.